DIFFERENTIAL EFFECTS OF PHOTOPERIOD ON DEVELOPMENT OF SOLANACEOUS WEED SPECIES

Anita Kamboj, Douglas Doohan, and Joel Felix
Ohio Agricultural Research and Development Center, The Ohio State University, Wooster

Abstract

The effect of three photoperiod treatments (10/14, 14/10 and 16/8 h of light and dark intervals) on the growth and development of Solanaceous weeds viz. apple of Peru (*Nicandra physalodes),* clammy ground cherry (*Physalis heterophylla*), eastern black nightshade (*Solanum ptycanthum*), horsenettle (*Solanum carolinense*) and smooth ground cherry (*Physalis angulata*) was evaluated. Species responded differentially to photoperiod but they all grew well at 16/8 h. Solanaceous species need to reach a critical stage of plant development before photoperiod becomes directive. Apple of Peru and eastern black nightshade were tallest. Apple of Peru in 16/8 h photoperiod had the most leaves. The number of days to flower was significantly reduced with 10/14 h both in apple of Peru and eastern black nightshade; while, horsenettle, smooth- and clammy ground cherry did not flower at all. Final leaf area and plant dry matter accumulation were greater in the 14/10 h photoperiod than in the 10/14 h photoperiod for all the species; no additional increase was noted amongst plants in the 16/8 h photoperiod.

Introduction

Eastern black nightshade is an important weed of croplands in Ohio and apple of Peru is an emerging invasive weed, first noticed in counties of Seneca and Sandusky in 2002. Solanaceous species produce seed under a wide spectrum of radiation, thermal and spatial conditions. We hypothesized that tolerance of photoperiod with respect to growth and reproduction might confer greater competitiveness to these species relative to other Solanaceous weeds. To test this hypothesis growth and reproduction of both species was compared to that of clammy ground cherry, smooth ground cherry and horsenettle under controlled photoperiod regimes.

Methodology

Three seeds of each species were sown in 10,000 cm^3 pots filled with a commercial green house mix (PRO-MIX'BX'). The green house room temperature was maintained at 28^0C/ 16^0C (day/night). Plants were watered three times a day. Photoperiod regimes were 10/14, 14/10 and 16/8 h of light/dark. Potted plants were moved into the tents 24 h after sowing seeds. Pots were thinned to one plant at the 1 true leaf stage. The experiment design was a split plot with 4 replications, with photoperiod in main plots and species in the sub-plots. The data were analyzed using the PROC GLM in SAS.

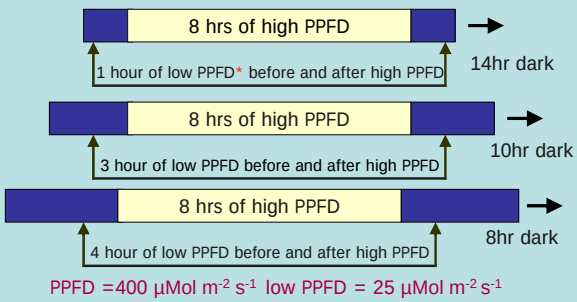

Fig.2. Sequence of light and dark periods during photoperiod treatment

Results and Discussion

Table 1. Effect of photoperiod treatment on plant height (cm) of several Solanaceous weeds

Photoperiod	21DAE*	28DAE	52DAE	At flowering
AOP* 10/14	8.9	9.6	39.8	88.0
14/10	8.9	13.8	55.3	108.5
16/8	9.3	16.5	99.5	107.1
CGC 10/14	2.9	4.3	20.2	16.5
14/10	2.8	4.3	24.6	58.4
16/8	3.0	4.7	28.1	92.0
EBN 10/14	5.1	5.0	44.1	35.5
14/10	5.1	8.8	101.7	65.8
16/8	5.4	9.8	101.3	83.8
HN 10/14	2.8	3.9	8.0	3.1
14/10	2.9	4.3	17.4	20.3
16/8	3.0	4.7	20.6	75.0
SGC 10/14	3.0	4.1	12.4	18.9
14/10	2.6	4.3	23.4	81.9
16/8	3.1	4.8	29.8	90.3
LSD (5%)	0.5	1.1	4.4	26.6

*DAE = days after emergence; AOP=Apple of Peru; CGC=Clammy ground cherry; EBN=Eastern black nightshade; HN=Horsenettle; SGS=Smooth ground cherry.

- Apple of Peru and eastern black nightshade were 73 and 96% taller 28 DAE in the 16/8 h photoperiod than in the 10/14 h photoperiod (Table 1).
- Differential height response of clammy ground cherry, horsenettle and smooth ground cherry to photoperiod was not detected until 52 DAE.
- The apple of peru and EBN respond similarly to environmental stimuli. Apple of Peru is likely to become a major weed problem in similar environments where EBN is observed.

Table 2. Effect of photoperiod on leaf count in several Solanaceous species

Photoperiod	14DAE	21DAE	28DAE	52DAE
AOP 10/14	4.9	10.2	13.1	107.9
14/10	5.1	10.3	15.1	124.6
16/8	5.5	11.0	17.5	131.6
CGC 10/14	1.5	1.7	2.1	6.8
14/10	2.1	2.7	4.4	31.0
16/8	2.5	3.8	6.2	56.1
EBN 10/14	1.9	2.1	3.5	10.9
14/10	2.7	4.9	9.2	78.1
16/8	2.8	5.7	11.2	82.4
HN 10/14	1.5	1.8	1.9	2.83
14/10	1.9	2.2	2.8	17.9
16/8	2.2	2.8	3.8	23.5
SGC 10/14	1.1	1.6	1.7	5.01
14/10	1.4	2.3	3.8	41.3
16/8	1.8	3.3	5.4	46.1
LSD (5%)	0.4	1.1	1.9	8.7

- Leaf number increased with extended photoperod for all species (Table 2).
- Apple of Peru produced the most leaves followed by eastern black nightshade.
- Extended photoperiods affected apple of Peru and eastern black nightshade leaf number after 28 DAE.
- Extended photoperiods affected clammy ground cherry leaf number after 14 DAE but plants were generally smaller than apple of Peru and eastern black nightshade.

Table3: Effect of photoperiod on days to flowering on several Solanaceous weeds.

- Increase in light period delayed flowering in apple of Peru and eastern black nightshade (Table 3).
- Clammy ground cherry, horsenettle and smooth ground cherry did not flower at 10/14 h treatment.

Photoperiod	AOP	CGC	EBN	HN	SGC
10/14	26.1	-	27	-	-
14/10	36.8	68.9	33.8	108	62.4
16/8	35.3	63.4	36.1	98	60.9
LSD (5%)	---------- 4.3 ----------				

Table 4.Effect of photoperiod on leaf area at harvest, top and root dry matter accumulation.

Photoperiod	Leaf Area (cm^2)	Top dry weight (g)	Root dry weight (g)
AOP 10/14	2408	23.5	1.8
14/10	2673	33.8	3.5
16/8	2959	39.3	4.1
CGC 10/14	1155	9.0	4.7
14/10	2657	32.2	18.8
16/8	2953	35.3	19.1
EBN 10/14	1677	17.0	5.3
14/10	4454	32.6	7.9
16/8	4405	40.0	10.8
HN 10/14	162.6	1.2	1.2
14/10	1448	9.6	9.3
16/8	6731	26.4	12.6
SGC 10/14	1578	10.2	7.4
14/10	2321	23.8	8.7
16/8	2261	24.2	5.8
LSD (5%)	1547	16.6	5.5

- Leaf area increased as photoperiod increased. Increased leaf area was not observed beyond the 14/10 h treatment except horsenettle which produced more leaf area with the 16/8 h photoperiod (Table 4).
- Apple of Peru and eastern black nightshade achieved the greatest dry matter content, followed by clammy ground cherry and smooth ground cherry. Horsenettle accumulated the least dry weight.
- Clammy ground cherry root dry weight was greater than the other. Horsenettle responded to longer photoperiods by accumulating more dry matter in the roots than did other species without significant increase in dry matter accumulation in the aerial parts of the plant

Conclusions

- Apple of Peru and Eastern black nigtshade were more responsive to photoperiods with respect to flowering.
- Highest leaf area in eastern black nightshade, for all the treatments implied the resource constrains it may impose to the crop.
- Relatively more top dry matter than root dry matter indicated the competitive establishment of the weed in a crop field by acquiring more space, thus restricting the development of crop plants in the vicinity.